Beware of the B(e)all Valve
Mistaken Valve Identity, 30-Year Survival, and Valve Replacement

Effective management of patients after the implantation of mechanical cardiac valves includes correct recognition of each valve and its related complications. Herein, we present the case of a patient who had undergone implantation of a floating-disc Beall-Surgitool mitral valve in 1976 and developed multiple valve-related complications. Over 30 years and in multiple medical centers, the device was mistakenly assumed to be a “ball” valve. The correct identification of the prosthesis led to the recognition of valvular failure, and the patient underwent its replacement with an On-X bileaflet carbon valve. Pathologic and microscopic examination of the explanted Beall valve showed massive pannus formation that extended over the sewing cuff on the atrial and ventricular side, preventing complete disc closure; disrupted fabric coating of the sewing ring, with exposure of the underlying metal; and a marked inflammatory reaction. We report one of the longest intervals on record between the implantation and replacement of a Beall-Surgitool valve. (Tex Heart Inst J 2010;37(2):237-9)

After mechanical cardiac valve implantation, effective management includes recognition of the valve and complications that may be related. Herein, we describe the unique case of a patient who experienced multiple, long-term cardiac and systemic complications over 30 years because of “mistaken valve identity.”

Case Report

A South American woman developed rheumatic mitral stenosis during childhood. In 1976, at age 21 years, she underwent mitral valve replacement in the United States, followed by appropriate chronic anticoagulation therapy with warfarin. Four years later, on 2 occasions, she experienced repeated episodes of atrial fibrillation, non-ST-segment–elevation myocardial infarction (NSTEMI), and transient ischemic attacks. She then developed hemolytic anemia and sick sinus syndrome, this last necessitating pacemaker placement. Amiodarone therapy was complicated by toxicity that caused restrictive lung disease and hypothyroidism. Her left ventricular ejection fraction gradually declined to 0.35–0.40, in association with symptoms of congestive heart failure (New York Heart Association functional class II).

As the years progressed, the patient experienced transient ischemic attacks and renal impairment. Clinical notes from various medical centers repeatedly mentioned “mechanical valve,” “ball valve,” “ball-in-cage prosthesis,” or “Starr-Edwards mitral valve.” Repeat cardiac angiography at various medical centers revealed no significant coronary atherosclerosis. However, reports included the presence of a functioning mechanical valve. In 2004, an embolus to the left circumflex coronary artery was identified. In December 2005, 29 years after the mitral valve prosthesis was implanted, the patient experienced 2 additional NSTEMIs within a period of 3 weeks and was transferred to our medical center. Upon admission, she reported chest pain, shortness of breath, and marked fatigue; she also had rapid atrial fibrillation. On auscultation, we detected remote and irregular cardiac sounds with a metallic opening sound but no audible closure sound, severe mitral regurgitation, and mild congestive heart failure. Laboratory tests revealed anemia with a hemoglobin level of 10 g/dL and schistocytes on the peripheral smear. An elevated lactate dehydrogenase level (705 IU/L; reference range, 98–192 IU/L) and a very low haptoglobin level (<6.5 mg/dL; reference range, 34–200 mg/dL) were consistent with hemolysis, and the platelet count was 141 ×
The cardiac troponin level was 2.1 ng/mL, and the creatine kinase level was normal. Transesophageal echocardiography revealed global hypokinesis and a left ventricular ejection fraction of 0.35. The mitral valve prosthesis had a mean gradient of 5 mmHg. Mild-to-moderate paravalvular regurgitation was noted, as was a linear, markedly mobile, highly echodense structure that prolapsed into the left atrium during systole. Coronary angiography revealed no evidence of coronary artery disease; however, rocking motion from a calcified prosthetic mitral valve was detected. The classic metal cage of a caged-ball prosthesis was not seen. Immediate consultation with a senior cardiothoracic surgeon led to the identification of a floating-disc prosthetic mitral valve. When questioned, the patient insisted that she had received a “ball valve” in 1976. She presented an authentic valve card and remarked that the card had never been requested since the operation. The card, dated 7 September 1976, registered a Beall-Surgitool model 106 medium-sized mitral valve.

In view of the patient’s multiple long-term complications from the dysfunctional prosthetic valve, and on the basis of a literature search that attested to its high failure rates, valve replacement was indicated. Sternotomy via a transseptal approach was performed, and the mitral valve was inspected. The disc occluder had clots that adhered to its ventricular aspect (Fig. 1), blocking the disc occluder from complete closure and causing mitral regurgitation. Pannus growth into the annulus and disruption of the annulus cloth coverage (exposing the underlying metal) were noted. The Beall-Surgitool valve was excised and replaced with a 31-mm On-X® bileaflet pyrolyte carbon valve (On-X Life Technologies, Inc.; Austin, Tex). There were no surgical complications, and the patient recovered well. She had no further cardiac symptoms but continued to have atrial flutter with a controlled ventricular rate.

Pathologic examination of the explanted valve revealed a freely mobile, intact disc in a metallic housing. A massive pannus formation extended over the sewing cuff of the valve on the atrial side, preventing the disc from completely closing. Extensive pannus formation was also observed on the valve’s ventricular side. The fabric coating of the sewing ring was disrupted, and the underlying metal was exposed. No vegetations were present. Microscopic examination revealed a marked inflammatory reaction that consisted of multinucleated giant cells, histiocytes, lymphocytes, and occasional plasma cells. Dense fibrous tissue and focal areas of calcification were also seen. Stains for various organisms were negative.

In April 2009, the patient returned for examination for the 1st time since the implantation of the On-X valve, reporting chest pain and dyspnea. Physical examination revealed normal cardiac and prosthetic mitral valve sounds and no evidence of congestive heart failure. Electrocardiography showed atrial fibrillation without ischemic changes. Results of blood tests were normal, including hemoglobin level and platelet count. Transesophageal echocardiography showed global hypokinesis, a left ventricular ejection fraction of 0.35, adequate functioning of the On-X mitral valve, mild residual paravalvular leakage, and a very large left atrium without thrombus. A myocardial perfusion stress test revealed multiple areas of fixed defects and several areas of peri-infarction ischemic reversibility. Coronary arteriography showed patent coronary arteries, and a pulmonary function test revealed mild restrictive lung disease. At her last clinical visit (January 2010), the patient was asymptomatic, and the new prosthetic valve was functioning adequately.

Discussion

Our patient is one of the longest known survivors of an implanted Beall-Surgitool mitral valve. Unfortunately, repeatedly mistaken valve identification led to inadequate recognition of valve-related complications over many years. This occurred, in part, because of constant reliance on the patient’s account of having received a “ball valve.” Therefore, regrettably, “elephant medicine”...
was practiced—mindless reliance on previous diagnoses and assumptions. Of note, a thorough physical examination should have detected the difference between a caged-ball valve and a disc valve. Such loss of acumen in cardiac physical examination is frequently lamented in the medical literature. Our case exemplifies the potential for a recipient to misunderstand an implant’s name. Accordingly, obtaining original documents, such as a valve identification card, is of paramount merit. Proper fluoroscopic, echocardiographic, and radiographic recognition of different prosthetic valves remains invaluable.

The development, clinical use, recognized complications, and eventual decline of the Beall valve are noteworthy. The Beall-Surgitool prosthetic valve, invented by Dr. Arthur Beall, was the most widely used mechanical valve in the world from 1965 until the mid-1970s. Models 103 through 106 of the Beall-Surgitool valve were introduced. In models 103 and 104, the poor durability of the Teflon disc resulted in prosthesis malfunction. Baille and colleagues described their experience with 21 explanted malfunctioning Beall-Surgitool model 104 mitral prostheses. Pathologic changes in the valve included kinked discs, eroded mountings, and torn Teflon rings. These complications most commonly occurred 4 years after implantation. Silver and Wilson concluded that severe valvular wear was inevitable over time in all patients. Specifically, the deterioration would permit the disc to tilt into the valvular lumen, stick in the open position, or occasionally escape from its cage. Subsequently, Beall-Surgitool models 105 and 106 were introduced. Model 106 had a pyrolyte carbon coating of the disc and cage to prevent disc wear. The base of the valve was covered with Dacron velour, in order to eliminate the interface between the metal seat and the cloth sewing ring. In theory, only the cage and the disc occluder would be in contact with blood, thereby decreasing overall thrombogenicity. The valve had a unique radiographic appearance and could be readily recognized upon fluoroscopy. Although most patients who received the Beall valve model 106 noted symptomatic improvement, late abnormal hemodynamic function—particularly during exercise—was discovered. Over years of follow-up, thromboembolic events became a major clinical concern. Hemolysis, anemia, and congestive heart failure were also commonly seen. Disc embolization many years after implantation was also reported.

Fernandez and colleagues reported their experience with 610 model 106 valves over a 10-year period. Of these, 89 (14%) were subsequently explanted. Examination revealed intact discs—a difference from the progressive wear, notchting, and occasional disc escape that were noted with models 103 and 104. (Notably, similar developments occurred with another well-known flat-disc mechanical valve, the Kay-Shiley.) Eventually, in light of the unacceptable wear of the valvular components, the Beall valve fell out of favor. From a clinical standpoint, it was recommended that the valve be replaced—either before a complication occurred, or after the first sign of thromboembolic episodes, severe anemia, or cardiac failure.

Summary
A Beall mechanical mitral valve that was mistaken for a caged-ball valve caused multiple cardiac and systemic complications in a woman over a period of 30 years. After the Beall-Surgitool valve was correctly identified and a diagnosis of valvular failure was made, the prosthesis was replaced with an On-X bileaflet carbon valve, which led to the patient’s substantial clinical improvement. In caring for patients who have mechanical valves, precise recognition of the type of valve is essential. Correlation between physical examination, radiologic findings, and echocardiographic findings is paramount for adequate identification and management.

References